

SCIENCE

Chapter 18: Cell – Structure and Functions



Cell – Structure and Functions

Cell as the Basic Unit of Life

- The cell is the basic structural and functional unit of all living organisms.
- It is the smallest part of the body of an organism, is capable of independent existence and is able to perform the essential functions of life.

Discovery of the Cell

- **Robert Hooke** observed cork cells under a simple microscope designed by him.
- He observed compartments resembling honeycombs and each compartment was separated by a wall.
- He termed each compartment as a '**cell**'.
- It was the first indication that living organisms are made of cells.

Cell Theory

- In 1838, Matthias Schleiden and Theodor Schwann proposed the basic cell theory. In 1858, another scientist Virchow made an addition to the existing cell theory.
- The postulates of the modern cell theory are
 - ✓ The cell is the smallest unit of structure of all living things.
 - ✓ The cell is the unit of function of all living things.
 - ✓ All cells arise from pre-existing cells.

Variety in Cells

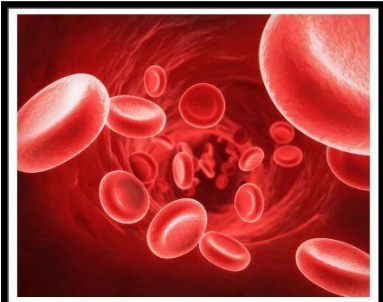
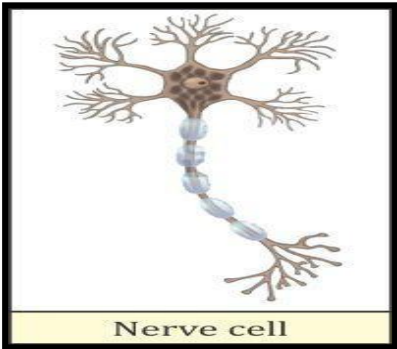

On the basis of the number of cells

Single-celled	Few-celled	Multi-celled
---------------	------------	--------------

- | | | |
|--|--|---|
| <ul style="list-style-type: none"> Organisms made of a single cell. They are called unicellular organisms. Examples: Bacteria, Yeast, <i>Chlamydomonas</i>, <i>Amoeba</i>, <i>Paramecium</i> | <ul style="list-style-type: none"> Organisms made of a few hundred to few thousand cells. Examples: <i>Spirogyra</i>, <i>Volvox</i> | <ul style="list-style-type: none"> Organisms made of millions to billions of cells. They are called multicellular organisms. Examples: Man, cow, mango tree, crow |
|--|--|---|

On the basis of size of cells

- Smallest cell: Examples: Bacteria (0.3–5.0 μm), red blood cells (7 μm)
- Longest cell: Example: Nerve cell in the neck of a giraffe (>3 m long)
- Largest cell: Example: Ostrich egg (170 mm \times 130 mm)

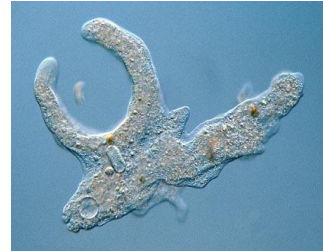
Smallest cell	Longest cell	Largest cell
 <p>Red blood cells</p>	 <p>Nerve cell</p>	 <p>Ostrich egg</p>

On the basis of shape of cells

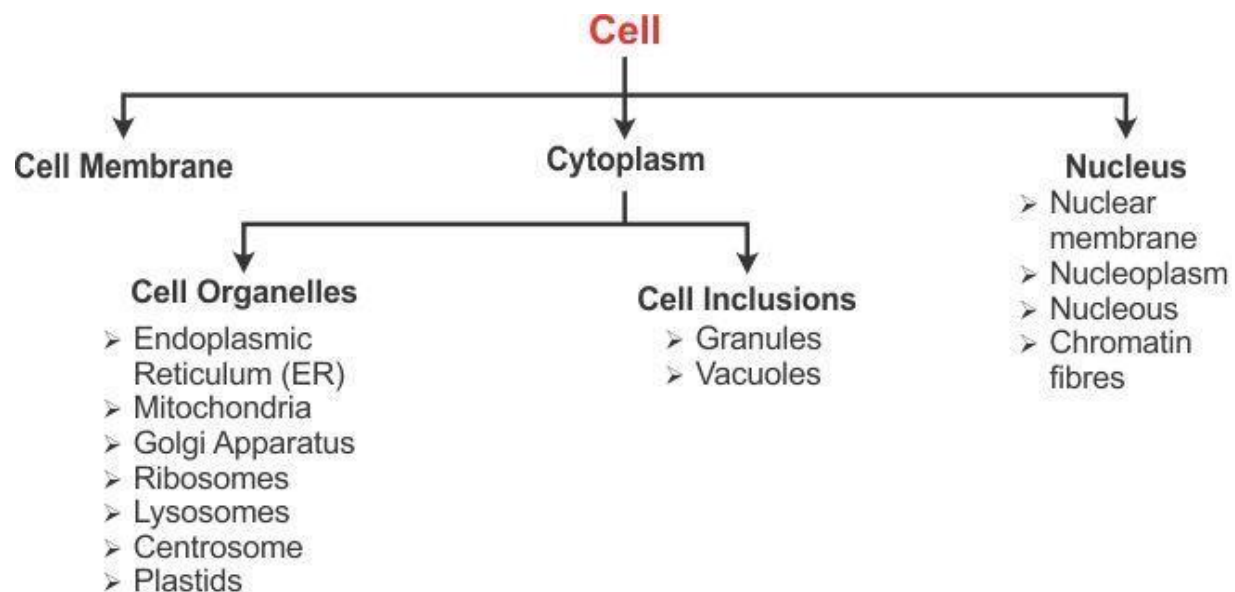
- Columnar: Epithelial cells
- Spherical: Human ovum
- Oval: Fat cells
- Spherical, biconcave: Red blood cells
- Rectangular: *Spirogyra*
- Spiral: Sperm cell
- Rod-shaped: Bacteria
- C-shaped: Cartilage cells
- Cylindrical: Striated muscle fibre cells
- Branched: Nerve cells
- Spindle-shaped: Smooth muscle cells
- Bean-shaped: Guard cell from a plant leaf

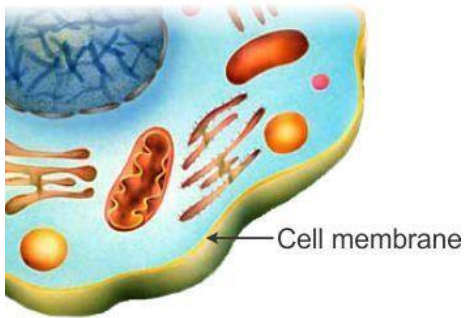
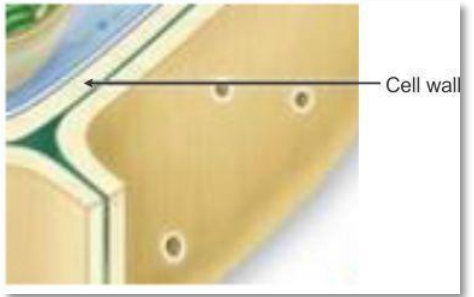
- Irregular: Amoeba

Amoeba is irregular in shape. It changes its shape continuously due to the presence of pseudopodia. The change in shape helps *Amoeba* in movement and in capturing food.



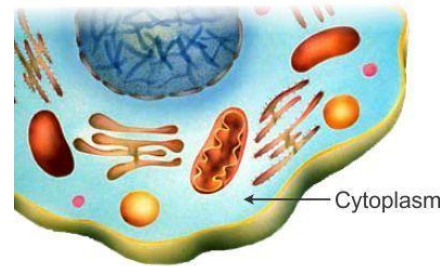
Structural Organisation of a Cell



CELL ORGANELLES		
NATURE AND OCCURRENCE	MAIN CHARACTERISTICS	MAIN FUNCTIONS
1. Plasma membrane/Cell membrane <ul style="list-style-type: none"> Forms the outermost covering in animal cells Lies next to the cell wall in plant cells Separates cellular material from its surroundings Acts as an effective barrier and regulates the entry of substances in and out of the cell 		
2. Cell wall (in plant cells only) <ul style="list-style-type: none"> Found in plant cells Situated just outside the plasma membrane Mainly composed of cellulose Provides protection Gives rigidity and shape to plant cells 		

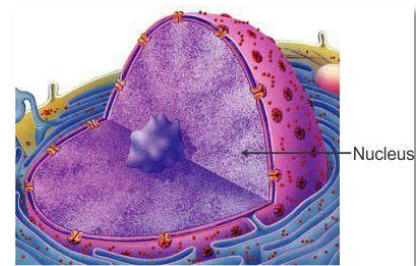
3. Cytoplasm

- Transparent jelly-like material
- Centre of all metabolic activities
- Different organelles contained in it perform different functions



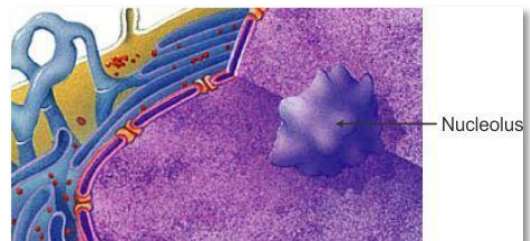
4. Nucleus

- Largest cell organelle
- Mostly spherical and dense
- Nuclear membrane with pores, which allow substances to enter and leave the nucleus
- Regulates cell functions
- Contains chromosomes, made of genes, which control hereditary characteristics



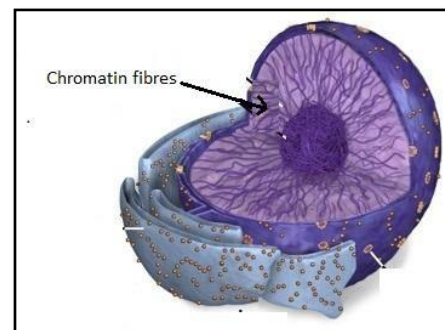
5. Nucleolus

- Embedded within the nucleus of the cell.
- One or more in number
- Produces ribosomes
- Participates in protein synthesis by forming and storing RNA



6. Chromatin fibres

- Network of thread-like structures made of DNA
- Chromosomes carry hereditary information or Genes



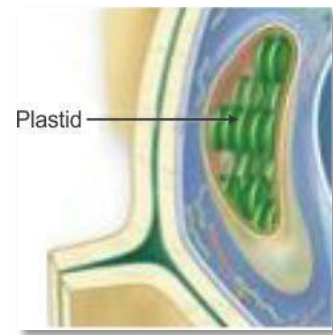
7. Vacuoles

- Fluid-filled membrane bound spaces
- Larger and permanent in plant cells
- Small and temporary in animal cells
- Storage of water and other substances, food, pigments and waste products
- Provides turgidity to the cells



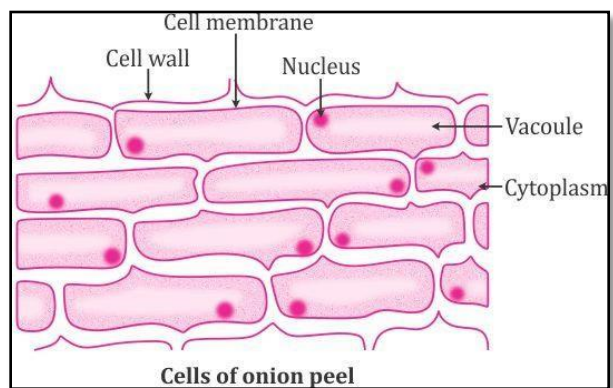
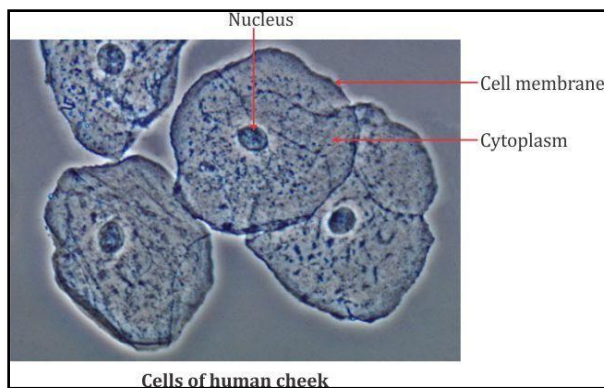
8. Plastids

- Three kinds of plastids.
- Chromoplasts: Impart colour to flowers and fruits
- Chloroplasts: Trap solar energy for photosynthesis
- Leucoplasts: Store starch
- Chloroplasts are chromoplasts which are disc-shaped and are filled with green colour chlorophyll.



The gene is a unit of inheritance in every living organism. It is responsible for the transfer of hereditary characteristics from parents to offspring. However, the offspring may receive different characteristics due to a different combination of genes from parents.

Study of Plant and Animal Cells



Similarities between Plant and Animal Cells

Presence of cell membrane

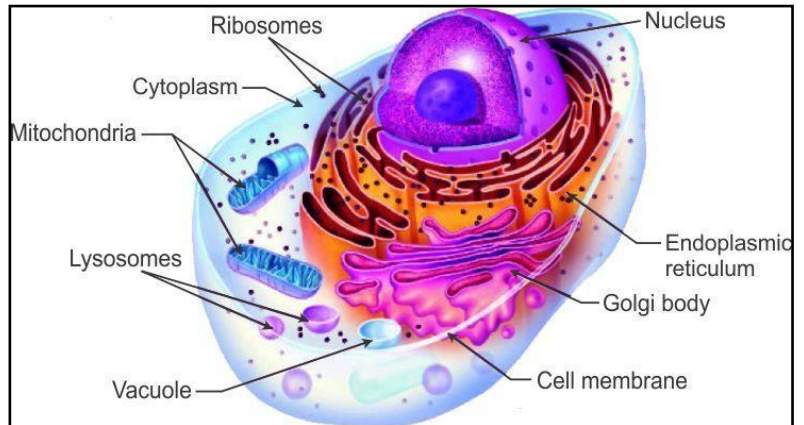
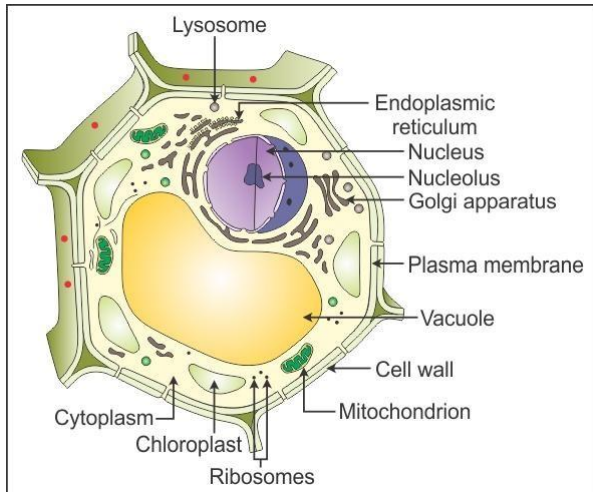
Presence of cytoplasm

Presence of nucleus

Presence of nuclear membrane

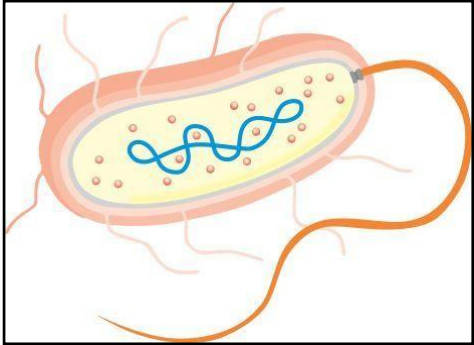
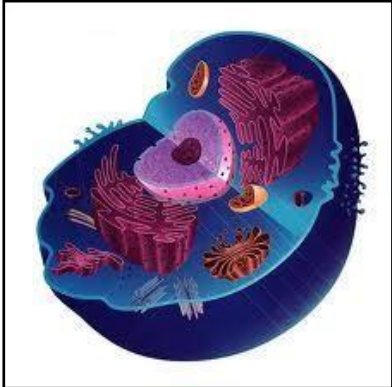
Presence of mitochondria

Differences between Plant and Animal Cells



PLANT CELL	FEATURE	ANIMAL CELL
Structural differences		
Presence of a definite cell wall made of cellulose	Cell wall	Absence of cell wall
Present internal to the cell wall	Cell membrane	Forms the boundary of the cell
Presence of one or more prominent vacuoles	Vacuoles	Presence of small and temporary vacuoles
Presence of plastids	Plastids	Absence of plastids
Functional differences		
Usually larger with distinct outlines	Size	Usually smaller with less distinct boundaries
Not so dense	Cytoplasm	Denser and more granular
Only a thin lining of cytoplasm, which is mostly pushed to the periphery	Arrangement of cytoplasm	Cytoplasm fills up almost the entire cell
Other differences		
Rectangular	Shape	Spherical
Starch	Storage material	Glycogen

Prokaryotic and Eukaryotic Cells

PROKARYOTIC CELL	FEATURE	EUKARYOTIC CELL
		
Absence of well-defined nucleus	Nucleus	Presence of well-defined nucleus with a nuclear membrane
Absent	Nucleolus	Present
Presence of a single length of only DNA	Genetic material	Presence of several lengths of DNA wound around certain proteins
Presence of smaller ribosomes	Ribosomes	Presence of larger ribosomes
Absence of other cell organelles	Cell organelles	Presence of several other cell organelles such as mitochondria, ER, chloroplasts etc.
Cell division occurs by fission or budding but not by mitosis	Cell division	Cell division occurs by mitosis or meiosis
Bacteria, blue green algae	Examples	<i>Euglena</i> , <i>Amoeba</i> , plants, animals

Important Questions

Multiple Choice Questions-

Question 1. Largest cell visible to unaided eye is:

- (a) hen's egg
- (b) ostrich egg
- (c) bacteria cell
- (d) nerve cell

Question 2. Which of the following is not a major component of protoplasm?

- (a) hydrogen
- (b) nitrogen
- (c) Sulphur
- (d) oxygen

Question 3. The organelle present only in plants is:

- (a) mitochondria
- (b) chromosomes
- (c) nucleus
- (d) plastids

Question 4. Which of the following is present only in plants:

- (a) plasma membrane
- (b) cell wall
- (c) nuclear membrane
- (d) cytoplasm

Question 5. Yolk is:

- (a) small part of cell
- (b) yellow part of egg
- (c) white part of egg
- (d) none of these

Question 6. The outermost layer of animal cell is:

- (a) cell wall

- (b) cell membrane
- (c) nuclear membrane
- (d) none of these

Question 7. The white part of egg is called:

- (a) yolk
- (b) albumen
- (c) cytoplasm
- (d) none of these

Question 8. The shape of amoeba is:

- (a) round
- (b) regular
- (c) irregular
- (d) none of these

Question 9. The basic structural unit of living organisms is:

- (a) cell
- (b) tissue
- (c) organ
- (d) none of these

Question 10. Is hen's egg a single cell:

- (a) no
- (b) yes
- (c) can't say
- (d) none of these

Very Short:

1. How many types of things are there on earth?
2. Name the structural unit of an organism.
3. What is cell?
4. What is cork?
5. Who discovered the cell and when?

6. What is basic structural unit of a building?
7. Is hen's egg a cell or group of cells?
8. Name a cell which can be seen by an unaided eye.
9. How do scientists observe and study the living cells?
10. How many cells are there in human body?

Short Questions :

1. If there is any difference between the vacuoles sizes in plant and animal. Explain.
2. Differentiate between unicellular and multicellular organisms.
3. Explain how Pseudopodia are helpful for Amoeba.
4. Name the part of cell which provides its shape.
5. Which component provides rigidity to plant cell?
6. Define Tissue.
7. Differentiate between Prokaryotes and Eukaryotes.
8. Relate Tissue to cell and organ.
9. Give example of some unicellular and multicellular organisms
10. Define the function of Plasma membrane.

Long Questions :

Question 1.

Differentiate between

- (a) Cell wall and cell membrane
- (b) Leucoplast and chloroplast
- (c) Vacuole in a plant cell and an animal cell
- (d) A tissue and an organ

Question 2.

What are the main functional regions of a cell? Explain.

Question 3.

Define cell membrane and state its functions.

Question 4.

Define nucleus and state its major parts.

Answer

1. Answer

(b) ostrich egg

Largest cell visible to unaided eye is ostrich egg.

2. Answer

(c) Sulphur

Sulphur is not a major component of protoplasm.

3. Answer

(d) plastids

The organelle present only in plants is plastids.

4. Answer

(b) cell wall

Cell wall is present only in plants. It is not present in animal cells.

5. Answer

(b) yellow part of egg

Yolk is yellow part of egg.

6. Answer

(b) cell membrane

Cell membrane is the outermost layer of animal cell.

7. Answer

(b) albumen

The white part of egg is called albumen.

8. Answer

(c) irregular

The shape of amoeba is irregular.

9. Answer

(a) cell

Cell is the basic structural unit of living organisms.

10. Answer

(b) yes

Yes, hen's egg is a single cell.

Very Short-

1. **Answer:** There are two types of things:

(i) Living things

(ii) Non-living things.

2. **Answer:** Cell.

3. **Answer:** The structural and functional unit of life is called cell.

4. **Answer:** Cork is the part of bark of a tree.

5. **Answer:** Robert Hooke discovered the cell in 1665.

6. **Answer:** Bricks.

7. **Answer:** Hen's egg is a cell.

8. **Answer:** Hen's egg.

9. **Answer:** By using highly magnifying microscopes.

10. **Answer:** There are trillions of cells in human body.

Short Answer-

1. Answer: The vacuoles size varies in plant and animal. Plant cell have single large sized vacuole, whereas animal cell have numerous small sized vacuoles.

2. Answer: Organisms made up of single cell are called unicellular organisms. Organisms made up of more than one cell are called multicellular organisms.

3. Answer: Pseudopodia help Amoeba in movement and in capturing the food.

4. Answer: Cell membrane provides cell its shape. Cell membrane is important for movement of substance both inward and outward of cell.

5. Answer: Cell wall provides rigidity to plant cell.

6. Answer: Tissue is a group of similar cells performing a specific function.

7. Answer: Prokaryotes do not have well organised nucleus and Eukaryotes have well organised nucleus with nuclear membrane.

8. Answer: Tissue is composed of cell and Organ is made up of tissue.

9. Answer: Unicellular organisms: Amoeba and Paramecium.

Multicellular organism: Human and Mouse.

10. **Answer:** Functions of Plasma membrane:

- Shape to the cells of plants and animals.
- Separates cells from one another and also the cell from the surrounding medium.
- Allows the movement of substances or materials both inward and outward.

Long Answer-

1. Answer:

(a) Cell wall and cell membrane

Cell wall	Cell membrane
I. It is present in only plant cells.	I. It is present in both plant and animal cells.
II. It is rigid, thick structure.	II. It is delicate, thin structure.
III. It is completely permeable to ordinary molecules.	III. It is selectively permeable to molecules.
IV. It is selectively permeable to molecules.	IV. It is metabolically active and living.

(b) Leucoplast and chloroplast

Leucoplast	Chloroplast
I. It is colourless plastid.	I. It is green plastid.
II. It is found in underground parts of plants like, roots, and underground modified stems.	II. It is found in green parts of plants like leaves, stem and sepals.
III. It help in storage of food.	III. It helps in photosynthesis.

(c) Vacuole in a plant cell and an animal cell

Vacuoles in plants	Vacuoles in animals
I. Plant cell vacuoles are large in size.	I. Animal cell vacuoles are smaller in size.
II. Usually a large central vacuole is found.	II. Usually a large central vacuole is found.
III. It is usually permanent structure.	III. It is mostly temporary structure.

(d) A tissue and an organ

Tissue	Organ
It is made of similar cells. Example: Muscle tissue, connective tissue, nerve	It is made of similar tissues. Example: Heart, lung, stomach, etc.

tissue, etc.	
--------------	--

2. Answer:

Main functional regions of a cell are:

- Plasma membrane: This is the membrane which makes the outer boundary of the cells. It is very thin, delicate and selectively permeable.
- Cytoplasm: Cytoplasm is viscous, transparent jelly-like substance of the cell. It contains cell organelles.
- Nucleus: Nucleus controls the working of the cell. It is a dense oval body lying in the protoplasm of the cell.

3. Answer:

Cell membrane or plasma membrane is a thin, delicate membrane surrounding the cytoplasm.

Following are the functions of cell membrane:

- It separates the cells from one another and also separates the cells from the surrounding medium.
- It gives a definite shape to the cell.
- Being porous, it allows the movement of substances from both inside and outside the cells.
- Its porous structure helps in regulating the movement of materials through the cells.

4. Answer:

Nucleus is a dense round body found in the Centre of an animal cell and mostly on the periphery of the plant cell. The nucleus controls all the activities in the cell like digesting movement of substances within the cell. Nucleus also controls the process of cell division. This is the reason nucleus is also known as the 'brain of the cell'.

Nucleus consists of four major parts. They are:

- Nuclear membrane
- Nucleoplasm
- Nucleolus
- Chromatin